

**What is claimed is:**

1. A system for diagnosing EGR valve-related failure conditions, comprising:  
an EGR valve having a valve inlet in fluid communications with an exhaust  
5 manifold of an internal combustion engine and a valve outlet in fluid communications  
with an intake manifold of said engine, said EGR valve responsive to a valve command  
to control exhaust gas flow therethrough;

an EGR position sensor producing an EGR valve position signal indicative of  
EGR valve position; and

10 an engine controller producing said valve command, said engine controller  
responsive to said EGR valve position signal and said valve command to determine  
when said valve command corresponds to commanding said EGR valve from one of a  
fully closed and a fully open position thereof to one of a fully open and a fully closed  
position thereof, said controller thereafter responsive to said valve position signal to  
15 measure a response time between said one of a fully closed and a fully open position  
and said one of a fully open and fully closed position, said engine controller logging an  
EGR valve response time fault if said response time is greater than a response time  
limit.

20 2. The system of claim 1 wherein said controller is configured to measure a  
voltage associated with said EGR valve sensor if said response time is below said  
response time limit, said controller logging an EGR valve position sensor in-range fault  
condition if said voltage is one of greater than a fully open sensor voltage threshold and  
less than a fully closed sensor voltage threshold.

25 3. The system of claim 2 wherein said controller is configured to log an EGR  
valve position sensor in-range high fault if said voltage is greater than said fully closed  
voltage threshold when said valve command corresponds to commanding said EGR  
valve from said fully open to said fully closed position.

4. The system of claim 2 wherein said controller is configured to log an EGR valve position sensor in-range low fault if said voltage is less than said fully open voltage threshold when said valve command corresponds to commanding said EGR valve from said fully closed to said fully open position.

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5. The system of claim 1 further including a vehicle battery connected to said EGR position sensor, said controller logging said fault only if a voltage of said battery is within a predefined voltage range.

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6. The system of claim 1 further including:  
means for determining an operating temperature of said engine and producing an engine temperature signal corresponding thereto; and  
means for determining ambient temperature and producing an ambient temperature signal corresponding thereto, said controller logging said fault only if said engine temperature and said ambient temperature are both below a temperature threshold.

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7. A system for diagnosing EGR valve-related failure conditions, comprising:  
an EGR valve having a valve inlet in fluid communications with an exhaust manifold of an internal combustion engine and a valve outlet in fluid communications with an intake manifold of said engine, said EGR valve responsive to a valve command to control exhaust gas flow therethrough;

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means for determining a position of said EGR valve and producing an EGR valve position signal corresponding thereto; and

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an engine controller producing said valve command, said engine controller responsive to said EGR valve position signal and said valve command to determine when said valve command corresponds to commanding said EGR valve from one of a fully closed and a fully open position thereof to one of a fully open and a fully closed position thereof, said controller thereafter responsive to said valve position signal to determine a final valve position after a time delay following said valve command, said

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engine controller logging an EGR valve response time fault if a difference between said final valve position and an expected valve position is greater than a position threshold.

8. The system of claim 7 wherein said controller is configured to measure a voltage associated with said EGR valve sensor if said difference is less than said position threshold, said controller logging an EGR valve position sensor in-range fault condition if said voltage is one of greater than a fully open sensor voltage threshold and less than a fully closed sensor voltage threshold.

9. The system of claim 8 wherein said controller is configured to log an EGR valve position sensor in-range high fault if said voltage is greater than said fully closed voltage threshold when said valve command corresponds to commanding said EGR valve from said fully open to said fully closed position.

10. The system of claim 9 wherein said controller is configured to log an EGR valve position sensor in-range low fault if said voltage is less than said fully open voltage threshold when said valve command corresponds to commanding said EGR valve from said fully closed to said fully open position.

11. The system of claim 7 further including a vehicle battery connected to said EGR position sensor, said controller logging said fault only if a voltage of said battery is within a predefined voltage range.

12. The system of claim 7 further including:

means for determining an operating temperature of said engine and producing an engine temperature signal corresponding thereto; and

means for determining ambient temperature and producing an ambient temperature signal corresponding thereto, said controller logging said fault only if said engine temperature and said ambient temperature are both below a temperature threshold.

13. A method of diagnosing EGR valve-related failure conditions comprising the steps of:

monitoring a valve position of an EGR valve disposed between an exhaust manifold and an intake manifold of an internal combustion engine;

5 monitoring an EGR valve command;

determining from said valve position and said valve command when said valve command corresponds to commanding said EGR valve from one of a fully open and a fully closed position to one of a fully closed and a fully open position;

10 determining a final valve position after a time delay following said valve command commanding said EGR valve from said one of said fully open and said fully closed position to said one of said fully closed to said fully open position;

logging an EGR valve response time fault if a difference between said final valve position and an expected valve position is greater than a position threshold.

15 14. The method of claim 13 wherein said response time when said valve command corresponds to commanding said EGR valve from said fully open position to said fully closed position is less than said response time when said valve command corresponds to commanding said EGR valve from said fully closed position to said fully open position.

20 15. The method of claim 13 further including the steps of:

measuring a voltage associated with a sensor sensing said valve position if said response time is below said response time limit; and

25 logging an EGR valve position sensor in-range fault condition if said voltage is one of greater than a fully open sensor voltage threshold and less than a fully closed sensor voltage threshold.

30 16. The method of claim 15 wherein the step of logging an EGR valve position sensor in-range fault condition includes logging an EGR valve position sensor in-range high fault if said voltage is greater than said fully closed voltage threshold when said

valve command corresponds to commanding said EGR valve from said fully open to said fully closed position.

17. The system of claim 15 wherein the step of logging an EGR valve position sensor in-range fault condition includes logging an EGR valve position sensor in-range low fault if said voltage is less than said fully open voltage threshold when said valve command corresponds to commanding said EGR valve from said fully closed to said fully open position.

18. A method of diagnosing EGR valve-related failure conditions comprising the steps of:

monitoring a valve position of an EGR valve disposed between an exhaust manifold and an intake manifold of an internal combustion engine;

monitoring an EGR valve command;

determining from said valve position and said valve command when said valve command corresponds to commanding said EGR valve from one of a fully open and a fully closed position to one of a fully closed and a fully open position;

measuring a response time of said EGR valve from said one of said fully open and said fully closed position to said one of said fully closed to said fully open position;

logging an EGR valve response time fault if said response time is greater than a response time limit.

19. The method of claim 18 further including the steps of:

measuring a voltage associated with a sensor sensing said valve position if said difference is less than said position threshold; and

logging an EGR valve position sensor in-range fault condition if said voltage is one of greater than a fully open sensor voltage threshold and less than a fully closed sensor voltage threshold.

20. The method of claim 19 wherein the step of logging an EGR valve position sensor in-range fault condition includes logging an EGR valve position sensor in-range

high fault if said voltage is greater than said fully closed voltage threshold when said valve command corresponds to commanding said EGR valve from said fully open to said fully closed position.

5           21.    The system of claim 19 wherein the step of logging an EGR valve position sensor in-range fault condition includes logging an EGR valve position sensor in-range low fault if said voltage is less than said fully open voltage threshold when said valve command corresponds to commanding said EGR valve from said fully closed to said fully open position.

10           22.    A system for diagnosing EGR valve control system related failure conditions, comprising:

            an EGR valve having a valve inlet in fluid communications with an exhaust manifold of an internal combustion engine and a valve outlet in fluid communications with an intake manifold of said engine;

            an actuator responsive to a drive signal to control a position of said EGR valve;

            a position sensor producing a position signal indicative of actuator position;

            a current sensor producing a current signal indicative of actuator current;

            a valve controller responsive to an error signal corresponding to a difference between a valve command and said position signal to produce said drive signal; and

            an engine controller responsive to said valve command and said position signal to produce a position estimate, and to said valve command and said current signal to produce a current estimate, said engine controller diagnosing a properly functioning EGR valve control system if said error signal is less than a first threshold, a difference between said position signal and said position estimate is less than a second threshold and a difference between said current signal and said current estimate is less than a third threshold.

            23.    A system for diagnosing EGR valve control system related failure conditions, comprising:

an EGR valve having a valve inlet in fluid communications with an exhaust manifold of an internal combustion engine and a valve outlet in fluid communications with an intake manifold of said engine;

an actuator responsive to a drive signal to control a position of said EGR valve;

5 a position sensor producing a position signal indicative of actuator position;

a current sensor producing a current signal indicative of actuator current;

a valve controller responsive to an error signal corresponding to a difference between a valve command and said position signal to produce said drive signal; and

an engine controller responsive to said valve command and said position signal  
10 to produce a position estimate, and to said valve command and said current signal to produce a current estimate, said engine controller diagnosing a valve controller failure if said error signal is greater than a first threshold, a difference between said position signal and said position estimate is less than a second threshold and a difference between said current signal and said current estimate is less than a third threshold.

15 24. A system for diagnosing EGR valve control system related failure conditions, comprising:

an EGR valve having a valve inlet in fluid communications with an exhaust manifold of an internal combustion engine and a valve outlet in fluid communications  
20 with an intake manifold of said engine;

an actuator responsive to a drive signal to control a position of said EGR valve;

a position sensor producing a position signal indicative of actuator position;

a current sensor producing a current signal indicative of actuator current;

a valve controller responsive to an error signal corresponding to a difference  
25 between a valve command and said position signal to produce said drive signal; and

an engine controller responsive to said valve command and said position signal to produce a position estimate, and to said valve command and said current signal to produce a current estimate, said engine controller diagnosing a position sensor failure if  
30 said error signal is greater than a first threshold, a difference between said position signal and said position estimate is greater than a second threshold and a difference between said current signal and said current estimate is less than a third threshold.

25. A system for diagnosing EGR valve control system related failure conditions, comprising:

an EGR valve having a valve inlet in fluid communications with an exhaust manifold of an internal combustion engine and a valve outlet in fluid communications with an intake manifold of said engine;

an actuator responsive to a drive signal to control a position of said EGR valve;  
a position sensor producing a position signal indicative of actuator position;  
a current sensor producing a current signal indicative of actuator current;  
a valve controller responsive to an error signal corresponding to a difference between a valve command and said position signal to produce said drive signal; and

an engine controller responsive to said valve command and said position signal to produce a position estimate, and to said valve command and said current signal to produce a current estimate, said engine controller diagnosing a current sensor failure if said error signal is less than a first threshold, a difference between said position signal and said position estimate is less than a second threshold and a difference between said current signal and said current estimate is greater than a third threshold.

26. A system for diagnosing EGR valve control system related failure conditions, comprising:

an EGR valve having a valve inlet in fluid communications with an exhaust manifold of an internal combustion engine and a valve outlet in fluid communications with an intake manifold of said engine;

an actuator responsive to a drive signal to control a position of said EGR valve;  
a position sensor producing a position signal indicative of actuator position;  
a current sensor producing a current signal indicative of actuator current;  
a valve controller responsive to an error signal corresponding to a difference between a valve command and said position signal to produce said drive signal; and

an engine controller responsive to said valve command and said position signal to produce a position estimate, and to said valve command and said current signal to produce a current estimate, said engine controller diagnosing an actuator failure if said



error signal is greater than a first threshold, a difference between said position signal and said position estimate is greater than a second threshold and a difference between said current signal and said current estimate is greater than a third threshold.